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Research Appliction Summary

# Strengthening quality protein maize development and utilisation for indigenous chickens in Zimbabwe

Gasura, E.,[1]* Tarekegne, A.,[2] Maphosa, M.,[3] Maibvisira, N. A.,[1,2] Bidi, T.N.,[4] Ncube, S.,[4] Dube, A.B.[5] & Saidi, P.[4]
[1]Department of Crop Science, University of Zimbabwe, Box MP167, Harare, Zimbabwe
[2]International Maize and Wheat Improvement Center (CIMMYT)-Zimbabwe, P. O Box MP 163, Mount Pleasant, Harare, Zimbabwe
[3]Department of Crop and Soil Science, Lupane State University, Box AC 255, Ascot, Bulawayo, Zimbabwe
[4]Department of Animal Science, University of Zimbabwe, Box MP167, Harare, Zimbabwe
[5]Department of Animal Science and Rangeland Management, Lupane State University, Box AC255, Bulawayo, Zimbabwe
***Corresponding author:** egasura@agric.uz.ac.zw; gasurae@yahoo.com

## Abstract

Increasing household nutrition is a top priority in Zimbabwe where protein energy malnutrition is rampant among women and children. In rural areas, most people do not afford protein rich foods that include meat, meat products and other alternative sources. Yet, farmers in these areas are consuming maize and also grow indigenous chickens mainly based on the free range system. Ordinary maize is low in the essential amino acids, tryptophan and lysine, and thus stunted growth results not only among people but also among their animals, thus further complicating their potential sources for proteins. A maize mutant with twice as much the amount of lysine and tryptophan was discovered and termed quality protein maize (QPM). QPM is a major source of proteins for the resource poor farmers who are already growing and consuming maize. However, there are few available QPM varieties on the market due to difficulties and time consuming nature associated with breeding such varieties. Rapid and modern technologies such as marker-assisted selection are not easily applied to QPM breeding due to the fact that such technologies require optimization. When fully optimized, molecular breeding technology reduces the time, cost and drudgery associated with the conventional screening methods. Feeding trials of QPM provide concrete evidence on the benefits of this type of maize in increasing the animal growth rate and carcass quality. Animals fed with quality protein maize usually grow faster and bigger thus supplying the rural farmers with yet another excellent source of proteins and increased income.

Key words: Indigenous chickens, nutrition, protein source, quality protein maize, Zimbabwe

## Résumé

L'augmentation de la nutrition des ménages est une priorité au Zimbabwe, un pays où la malnutrition énergétique est courante chez les femmes et les enfants. Dans les zones rurales, la plupart des gens n'offrent pas d'aliments riches en protéines, notamment la viande, les produits à base de viande et autres sources alternatives. Pourtant, les agriculteurs

de ces régions consomment du maïs et élèvent également des poulets indigènes. Le maïs ordinaire est faible en acides aminés essentiels, le tryptophane et la lysine, et donc des résultats de croissance rabougris non seulement chez les personnes mais aussi chez les volailles, ce qui complique encore davantage les sources potentielles de protéines. Un gène mutant de maïs ayant deux fois plus de lysine et de tryptophane a été découvert et appelé maïs de qualité protéique (QPM). QPM est une source majeure de protéines pour les agriculteurs pauvres en ressources qui produisent et consomment le maïs. Cependant, il existe peu de variétés QPM disponibles sur le marché en raison des difficultés et le temps nécessaire pour produire ces variétés. Les technologies rapides et modernes telles que la sélection assistée par marqueurs ne sont pas facilement appliquées à la production des variétés QPM parce qu'elles nécessitent une optimisation. Lorsqu'elle est entièrement optimisée, la technologie moléculaire réduit le temps et le coût associés aux méthodes conventionnelles. Les essais d'alimentation avec la variété QPM fournissent des preuves concrètes sur les avantages de ce type de maïs dans l'augmentation du taux de croissance animale et de la qualité de la viande. Les animaux nourris avec du maïs de protéines de qualité se développent généralement plus rapidement et sont plus gros, fournissant ainsi aux agriculteurs ruraux une autre excellente source de protéines et un revenu accru.

Mots-clés: poulets indigènes, nutrition, source de protéines, maïs protéique de qualité, Zimbabwe

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**Background**

Improving the nutritional quality of agricultural crops is a noble goal. This is particularly important in cereals where the benefits can be spread to millions of people in a rapid and effective manner without changing the food habits (Vasal, 2000). The poor nutritional value of maize is well known and the need to improve it has been recognised for a long time (Vasal, 2000). Widely adapted quality protein maize provides an important opportunity to improve the nutritional quality of the worlds' major cereal crops. Quality protein maize breeding is however compounded by the difficulty in selecting improved lines. Since the *opaque-2* gene is recessive and expressed at the seed stage, breeding based conventional methods have a relatively longer period of time. Increasing application of molecular tools in quality protein maize research and development makes it possible to complement breeding efforts and expedite the breeding process.

Indigenous chickens are reared under subsistence farming in Zimbabwe. The extensive chicken production system in the smallholder set up has a number of advantages over the intensive system. These advantages include low capital requirements, minimum management and inherent tolerance of the indigenous chickens to harsh conditions. In addition, the production system is relatively organic producing cheap and high quality proteins. Indigenous chickens are a liquid asset and allow owners to convert them into cash. Therefore, the extensive indigenous production has the potential to improve food security and alleviate poverty in developing countries at large. In subsistence farming

systems chickens are left to scavenge to meet their nutritional needs. Their feed resources vary depending on local conditions. Development of village chicken enterprises can be a sustainable way of improving food security and livelihoods of the resource poor farmers (Kitalyi, 1998; Miao *et al.,* 2005). With the rising cost of poultry feeds, farmers rearing chickens are increasingly finding it difficult to make profit from poultry keeping (Lopez *et al.,* 1992). While it is difficult for farmers to formulate feeds for hybrid chickens such as broilers and layers, they can do so for their indigenous chickens under semi-intensive and intensive management systems. Chickens meant for meat production require feed with a higher content of digestible crude protein (Potter, 1987). This can be done using cheap sources of protein such as QPM which has been evaluated in a number of domestic animals such pigs and broiler chicken (Groote *et al.,* 2010; Mpofu *et al.,* 2012).

Poultry meat is an important source of protein for many households in Zimbabwe. Indigenous chicken production is widespread in Zimbabwe, with an estimated population of over 30 million birds. Recently there has been an upsurge in the demand for indigenous chicken which most people find tastier than exotic breeds (Kyarisiima *et al.,* 2011). However, most of these chickens are of mixed breeds and are produced under the low input and output system. Under this system there is limited feeding, housing and vaccination of birds that are normally left to scavenge for their food. Ultimately, there is very limited chicken productivity in terms of the number of chickens sold to the markets by the farmers. Although indigenous chickens are characterised by low productivity (30-80 small eggs per hen per year, high chick mortality rates, low body weights, etc.), they are hardy and tolerant to diseases. In Zimbabwe, less than 10% rural farmers supplement feeding of their indigenous chickens with a wide variety of crops depending on the time of the year (Chitate and Guta, 2001). In order to enhance indigenous chicken production a number of improvement programmes can be undertaken. One such programme could be the development and utilization of quality protein maize in the production of indigenous chickens.

**Analytical framework and methodology**

Poor household nutrition among the resource poor farmers in sub-Saharan Africa has been mainly due to inadequate access to quality and quantity of nutritious food throughout the year. These facets have been associated with the inadequate access to resources including adapted breeds and crop varieties constraints production at farm level. Despite the discovery of the *opaque-2* maize mutant with elevated levels of lysine and tryptophan (which was later termed quality protein maize, QPM) very few resource poor farmers have benefited from this technology. Most farmers in the region are growing and depending on maize and thus would benefit from the use of this innovative approach in solving common nutritional challenges. One major reason why the development of the QPM varieties was limited is because of the slow pace in breeding due to the recessive nature of the gene that control this novel trait. Thus most breeding programmes would need more time, more effort and more money with little return per research investment. This has caused most breeding companies to put less emphasis in the development of QPM hybrids. Furthermore, when released,

most farmers would not know the actual value of the QPM while the market will be reluctant to pay a premium price. This suggest some challenges on the utilization side where the benefits of QPM are under-estimated.

The use of molecular markers in foreground selection of QPM can help to circumvent the challenges associated with QPM breeding. This involves optimization of the common molecular markers that are known to be linked with the *opaque-2* gene that regulates the levels of lysine and tryptophan. Such markers, will help to improve the efficiency of breeding hence speeding up the rate at which new varieties are released on the market. To improve the adoption and utilization options for QPM, the maize produced will not only be recommended for human consumption but can also be used to feed the domestic animals that include indigenous chickens. The growth rates of animals have been shown to increase together with the quality of the carcass when the QPM based diets were used. Use of QPM based diets increases meat production thus the farmer's alternative source of proteins and income.

**Expected outcomes**

This research has recently been initiated in Zimbabwe. Key outputs of the research will be farmers preferred varieties with the elevated levels of lysine and tryptophan, indigenous breeds that respond well to QPM identified, the formulation of a diet with a positive growth response and human capital in the form of (two) MSc students and four (4) BSc students.

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